Case Record

Lokhe, a Hindu male, aged 40, agricultural labourer, was admitted to hospital on December 15th, 1931, with complaints of discomfort in the abdomen and difficulty in respiration for about two and a half months, and a history of cough with expectoration for one and a half years.

He was suffering from dyspnoea—not usually amounting to orthopnoea—pulmonary congestion, enlarged liver, and oedema. Although the heart was not enlarged there was myocardial weakness, the cardiac impulse being scarcely palpable and the sounds very poor. There was no murmur audible, and the pulse rate was 70 and below, with a regular rhythm. The arterial walls were soft and the pulse tension low. Beyond the congestion there were no pulmonary signs. The liver was moderately enlarged, firm, and tender. Pyorrhoea, lack of appetite, dyspepsia, and constipation were present. There was no ascites, and the spleen was not palpable. Oedema was to some extent general, but there was a much greater degree over the chest, arms, head, and neck than in the lower part of the body; the veins in the neck and the upper part of the chest were distended. The Wassermann reaction of the blood was completely positive. *X*-ray examination of the chest showed no indication of mediastinal growth, though the hilum shadows were prominent, especially on the right side.

It was considered that he had some obstruction to the superior vena cava, probably syphilitic, although the *x*-ray picture did not give much support to a diagnosis of syphilitic mediastinitis. The myocardial affection was thought to be undoubtedly syphilitic. Treatment by potassium iodide was initiated at once.

The oedema, especially of the face, became increasingly more obvious, and the pulse rate gradually slower. A partial heart-block appeared, many beats being dropped. The patient died quite suddenly on December 30th.

Post-mortem Examination

Oedema occurred in the lower limbs and round the ankles, but was present to a far greater degree over the head and neck, chest, and arms. No ascites. There were several ounces of blood-stained serum in both pleural cavities.

Pericardium.—The outer layer was thickened and adherent to the surrounding structures, especially round the termination of the superior vena cava and commencement of the aorta, which were intimately matted together. The visceral pericardium was free. The pericardial sac contained half an ounce of fluid.

Heart.—Size, small. The right auricle was normal externally, but its size was increased. On opening it from the front three globular, light grey gummata were observed, each about the size of a thumb-nail, projecting on a common base from the posterior wall of the auricle and slightly adherent to the anterior wall. They presented the appearance of small birds' eggs in an auricular nest. The gummata much obstructed the orifice of the superior vena cava, and, to a lesser degree, that of the inferior vena cava. Microscopical section showed gummatous structure. The right ventricle showed a fourth gumma immediately below the right auricle at the upper end of the right ventricular border. The left auricle was normal. The left ventricle showed some linear fibrosis in the myocardium. Microscopically there was congestion of coronary veins and slight fibrosis.

Aorta.—There were raised patches and slight scarring of syphilitic aortitis. The coronary arteries were patent, aortic and other valves normal.

Superior Vena Cava.—The wall was markedly thickened and oedematous, and dilated for the last six inches before its opening into the auricle. Endothelium was roughened and covered with greyish ante-mortem clot, the lumen being finally obliterated with red clot, which was the immediate cause of sudden death. The opening of the vein into the right auricle, as seen from the venous side, was almost obliterated by the round gummata which nearly filled the right auricular cavity. Blood could pass to the ventricle only by coursing over and around these gummata.

Inferior Vena Cava.—Similar changes were present, but to a lesser degree.

Liver.—This weighed 35 oz. Microscopically there were small areas of lymphocytic infiltration and venous congestion, but no necrosis or fibrosis.

Left Pleural Cavity and Lung.—The upper and front part of the cavity showed a cherry-sized nodule arising from the rib periosteum and penetrating the tissue of the anterior edge of the upper lobe of the left lung. The edge of this nodule was sharply defined and on microscopical section showed a gummatous structure.

Right Pleural Cavity and Lung.—This showed old firm adhesions along the posterior edge and at the base. An old calcareous nodule was present at the apex and one in the middle lobe—probably tuberculous.

Kidneys.—Weight, 3 and 2¼ oz.—normal.

Spleen.—Weight, 2½ oz.—normal.

No obvious abnormality was discovered elsewhere, and the liver, kidney, and spleen showed no amyloid change.

THE PRINCIPLES AND METHODS OF MALARIA CONTROL IN ASSAM*

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The object of this paper is to state the guiding principles for the control of malaria in Assam, and, as far as possible, the methods of control which we advocate. It is unnecessary here to emphasize the importance of control of a disease which causes a greater amount of sickness, inefficiency, and mortality than any other disease in the world, and the ravages of which have formed one of the greatest obstacles to colonization and civilization. Malaria is undoubtedly Assam's greatest problem, and has cost the local Government and the industries many crores of rupees.

Of the measures directed against adult mosquitos and their bites, nets, mosquito-boots, and screening are common-sense precautions; they are cheap and effective, and might be more widely used. Electric fans, punkahs, and repellents such as kerosene, citronella, and preparations containing pyrethrum are of use, as are sprays, discriminate jungle clearing, and animal prophylaxis. Jungle and other vegetation, provided it be not densely shading a malariogenic channel or swamp, may be cleared on the assumption that it affords shelter to anophelinae during the day time. The importance of animal prophylaxis is noticeable in species such as *A. maculatus, A. aconitus,* and *A. philippinensis,* which are known to be transmitters of human malaria when animal blood is not to any extent available. *A. minimus* is a "human blood lover," and the presence of animals, such as cattle and goats, is not, therefore, of much practical value.

Hand catching of adults is worth while in certain areas if it can be properly organized. Systematically performed, it reduces the number of infected adults, and is a valuable method for bungalows, hospitals, and jails. The establishment of adult "catching stations" is also a most useful method of testing the efficacy of anti-larval measures. "Catching stations" are selected shelters, preferably human habitations, where regular catches of anophelinae are made by the same collector for a stated time. This method frequently leads to the detection of dangerous breeding places which might otherwise be overlooked.

It will be seen that measures directed against adult mosquitos have a limited application as far as tea-garden labour forces or villagers are concerned. Measures directed against the larvae of malaria-transmitting mosquitos are, however, of more general application.

It has been proved that *A. minimus* is practically entirely responsible for the transmission of malaria in Assam. We have found that this species in nature breeds under certain defined conditions.

* An address to the Assam Branch of the British Medical Association, April, 1932.

(1) It selects, if possible, clear water, and avoids highly contaminated water: our observations have shown that malaria is most intense in districts where the waters are clearest. We define contaminated water as water containing a high degree of silt, clay, or the products of iron oxide organisms in suspension, and water highly polluted with effluents from factories, cowsheds, or human habitations. Highly contaminated water implies, under field conditions, the presence of that amount of silt, clay, or iron oxide products which prevents the bottom of a white collecting pan from being visible (roughly 2-inch column of water). Further, *A. minimus* will not breed if the surface of the water is covered with a thick scum of algae or a dense growth of aquatic vegetation such as lemna, wolffia, and azolla.

(2) It will breed in stagnant or slowly moving water, but is eliminated by high velocity of current. Thus it can breed in pools, borrow-pits, swamps, seepages, and at the edges of rivers, streams, and drains. In these latter channels it is most frequently found in the pools, pockets, and backwaters.

(3) It selects breeding places exposed or partially exposed to sunshine; it does not breed in water covered with dense shade. In the selection of breeding places and sites for oviposition it would seem as if vision to a great extent controls the habits of this mosquito, since larvae of this species can readily be hatched out in the laboratory in water highly contaminated with clay or iron oxide products, and they can be hatched out in darkened almirahs in water which has been collected from densely shaded channels.

That silt has a larvicidal action can be shown in the laboratory by passing air bubbles through water containing silt at a sufficient rate to keep it in suspension; normally all silt is deposited from suspension in stagnant water within thirteen minutes. In a series of experiments in which *A. minimus, A. philippinensis, A. fuliginosus, A. hyrcanus,* and *A. barbirostris* were introduced into jars containing water with a high percentage of silt, 50 per cent. of the larvae died within twenty-four hours, and the remaining 50 per cent. within 110 hours. The dead larvae were subsequently recovered from the silt-laden water by passing it through a fine wire-mesh sieve.

The importance of well-developed tail hooks and palmate hairs in *A. minimus* should also be emphasized, as this species can be found at the edges of a stream with a moderate current if the margins of the stream be grassy enough to afford a suitable hold for the hooks. Other species, with poorly developed tail hooks and palmate hairs, such as *A. umbrosus,* are unable to live under these conditions; hence they are invariably found in stagnant water and are easily eliminated by drainage.

ANTI-LARVAL MEASURES

These may be divided into (*a*) temporary and (*b*) permanent. The important temporary measures are chiefly the application of larvicides, while the important permanent measures are the application of methods to prevent the breeding of dangerous species, based on a knowledge of their bionomics.

(A) TEMPORARY MEASURES

These are, unfortunately, the only possible ones in many areas, especially where nature has been unduly interfered with by embankments and bridges, which upset natural drainage, and by irrigation schemes.

Oiling.—Certain petroleum oil products are the larvicides of choice for watercourses, rivers, streams, and drains, also for small collections of water such as pools and borrow-pits. Oiling of unshaded streams and channels should be by spraying, as larvae shelter among the weeds and grass at the edges, and the sprayed oil not only destroys the larvae but also burns up the vegetation. We do not recommend drip cans, because the oil is carried down by the current and may miss destroying the larvae which are sheltering at the edges. Balls and guddas for fairly large pools and borrow-pits are useful.

Paris Green.—Paris green is suitable for swamps and seepages, especially where these areas are cultivated, or where efforts are being made to re-establish dense shade. Oils cannot be applied to these latter areas, as they would destroy the crops or the shade vegetation which has been planted. Paris green does not damage crops in any way, nor in the percentage used is it harmful to man or animals. It requires more care and supervision in its application than oil. For mixing with a diluent, a mechanical mixer is advisable, and a practical point is that the rotation should be arrested at each revolution by a jerk of the handle in order to ensure thorough mixing. For narrow stagnant water channels, hand throwing is sufficient. For swamps and seepages in general a mechanical blower gives excellent results, while for large extensive swamps such as are found in the upper districts of Assam "aeroplane dusting" would appear to be the most suitable method.

(B) PERMANENT MEASURES

The factors underlying the important permanent measures based on the bionomics of *A. minimus* and the elimination of its breeding places are: (1) velocity of current, and (2) shade. We would stress the superiority of permanent over temporary measures; the former eliminate the human factor where temporary measures are liable to fail.

Drainage and Velocity of Current

We have found that slowly running, unshaded, clear-water drains are intensely malariogenic. For drainage to be safe, artificial channels must fulfil the conditions inimical to the breeding of *A. minimus*—that is, the water in the channels must be highly contaminated, densely shaded, or have sufficient velocity of current to eliminate this species. Hedges should not be planted over drains where the velocity of current is insufficient to prevent the channel from becoming blocked by the deposition of silt.

The most efficient method of drainage in Assam is by concrete inverts, and these should be so graded that there is sufficient velocity of current to carry away debris. The grade should be at least 1 in 200 to ensure sufficient flow, as water tidiness (absence of grass, weeds, etc.) does not prevent *A. minimus* from breeding in a channel lined with concrete; it has been found breeding in newly constructed cement-lined wells.

When constructing concrete drains it is essential to see that sufficient weep-holes be made in the sides of the drains for the entrance of subsoil water. Subdrainage in Assam is rarely a practicable measure owing to the high subsoil level of the water table, and therefore can be applied only in a few selected areas. The water reaches these drains by percolation, thereby converting these channels into underground streams. Rubble drains can be applied in much the same areas as subsoil pipes, if material be available, but the cost of both these methods is a great drawback. We would stress that drains in coolie lines normally have no effect on the malaria incidence, as they are usually too highly contaminated to breed the carrier species.

Swamps.—Generally speaking, swamps in Assam are undrainable in the monsoon season owing to the heavy rainfall. For this reason the only practical policy for dealing with malariogenic swamps is to allow them to return to nature; and nature can be assisted by replanting the swamps with appropriate vegetation. Unfortunately in Upper Assam many swamps are cultivated, and are dangerous during the transmission season owing to *A. minimus* breeding in contour and herring-bone drains or other channels. As many of these exposed channels in cultivated swamps cannot be oiled without destroying the crops, the only method to be advocated at present is the application of paris green, or to abandon the areas and allow them to revert to nature.

Rice Land.—The same applies to high-lying terraced irrigated land where the clear-water irrigating channels are also intensely malariogenic. Methods of dealing with such high-lying cultivated land are the periodic drying by controlled irrigation, or the cultivation of crops which are physiologically suited to this type of land, and therefore do not require irrigation.

Dangers of Drainage.—It is essential to stress the dangers of drainage generally in Assam, as clear-water slowly running drains form excellent breeding places for *A. minimus*. Clear-water malariogenic borrow-pits should not be connected up with the object of draining them, as thereby they are made more dangerous. Our method of dealing with borrow-pits is to break the impervious pan forming the base of the borrow-pits, to assist percolation, then to fill it with cut jungle or line refuse if sufficient soil be not available in the vicinity.

Shade

The terms "shade" and "jungle" are not synonymous. Jungle may refer to dense virgin forest, low bush or scrub, or even long grass, and may be patchy or dense. The only questions which concern the malariologist are whether it produces dense shade and covers watercourses or not.

We use the word shade in this paper as it is the real factor underlying our malaria problem. Shade may be absolute, dense, or partial. Absolute shade implies darkness due to the complete interception of rays of light—this is obtained by subsoil drainage. Dense shade implies the elimination of that degree or gradation of light under which vegetation containing chlorophyll can survive, and is inimical to the habits of *A. minimus*. Partial shade allows the growth of chlorophyll-containing vegetation, and is as dangerous as complete exposure to sunshine.

One practical test in the field of dense shade is the absence of grass beneath the shade. Vegetation used as shade should be biologically adapted to the terrain—for example, plants physiologically suited to aerated soil will not grow in swamps, and vice versa. The plants selected should be unsuitable as food for animals and should be strong enough to withstand being uprooted by storms. After planting hedges and swamps it is necessary to control with paris green until dense shade is established, as during the intermediate stages breeding places are not eliminated as long as sunshine can reach the water.

In Assam *A. umbrosus* and *A. aitkeni* are found in degrees of shade which are inimical to *A. minimus*, but to date we have never found even these species in really dense shade. It would appear that the habits of the two former species are greatly regulated by the effects of temperature, since during the colder periods of the year they have been found breeding in unshaded areas. This is especially noticeable in the case of *A. aitkeni* at high altitudes, as in Shillong.

Other Measures

Treatment of infected cases and of gametocyte carriers is a common-sense measure. Site selection is of primary importance. Watson[1] in Malaya and Christophers in the Andaman Islands showed that malaria was absent, or nearly so, in villages or estate coolie-lines which were over half a mile from the breeding places of dangerous mosquitos. In the past lines have been constructed in close proximity to malariogenic streams or swamps, often without any thought of possible unhealthiness. The policy in the future is obviously to avoid such mistakes which have been unwittingly made in the past, and to select more healthy sites for human habitations. Removal of existing lines to better sites is sometimes the most economical method of dealing with particular malaria problems, especially where embankments and bridges have created unnatural conditions and have made control by temporary or permanent measures extremely difficult or expensive.

Tanks.—In some areas abandoned clear-water tanks are the cause of much malaria, and in many cases it is now impossible to fill these. To obviate recurring expenditure on larvicides, we are experimenting with iron oxide organisms and other substances, with the object of introducing sufficient contamination to eliminate *A. minimus*. For tanks which are being used as a drinking-water supply, bamboo turzas at the margins are being tested with the object of producing dense shade.

Kutcha Wells.—Needless ones should be filled in, or in any case oiled until filled. Those required as drinking-water supplies should be covered.

Natural Enemies.—We consider that fish, water beetles, pond skaters, water-boatmen, may-fly and dragon-fly larvae, and other natural enemies are rarely of much practical value. Anopheline larvae are often found quite plentifully in grass and weeds in water teeming with so-called natural enemies, which would indicate that what can be shown in the laboratory does not always take place to any extent in nature.

Embankments.—The flooding of ravines by building embankments or bunds across the outlet with the object of burying seepages is especially dangerous in areas where the water is clear, and we do not recommend it.

Sluice Gates.—The method of attempting to produce velocity of current by sluice gates is likely to form pockets, and water is apt to flood over the banks and form pools, thereby creating fresh breeding places. This method is also fraught with danger and is rarely applicable.

It will be seen that to appreciate the fundamental factors underlying malaria control account must be taken of rainfall distribution, and the effect of transpiration, evaporation, percolation, and run-off, of soil composition, and the physical features of a district, also of the direction and strength of prevailing winds, temperature and humidity, distance of breeding places, etc. Former popular beliefs that dirty water and dense virgin jungle, hitherto called dank, rank, etc., were the sources of malaria in Assam have been shown to be erroneous, as also the idea that the pioneer who clears or drains is necessarily benefiting mankind. No longer will the phrase "clearing the dense virgin jungle" have about it a resounding note of pioneering heroism, as we now know that the anopheline mosquito, which transmits our malaria, does not breed under dense shade, or in water which appears to be noisome or revolting, but in clear water exposed or partially exposed to sunshine. In future the control of malaria in Assam will mean less interference with nature and a realization of the fact that the green beauty of vegetation covering rivers, streams, and swamps can be allowed to remain with improved health to mankind.

Reference

[1] Watson, Sir Malcolm: *Prevention of Malaria in the Federated Malay States.*

Memoranda

MEDICAL, SURGICAL, OBSTETRICAL

ACUTE LOCALIZED PHLEGMONOUS ENTERITIS COMPLICATING PREGNANCY

The following case recently came under my care at the Bedford County Hospital.

The patient, a domestic servant aged 20, was admitted to hospital at 10.30 p.m. on June 1st, 1932, with the history that, except for a mild attack of abdominal pain three years ago, diagnosed as appendicitis, she had enjoyed good health. There had been amenorrhoea since January, 1932. At 6 a.m. on June 1st while in bed she was seized with violent abdominal pain; two hours later she vomited, and the pain and vomiting continued all day. In the evening pain also developed at the top of the right shoulder. On examination she was flushed and a little cyanosed, the tongue furred, temperature 102.4° F., pulse 130, respiration 34. The abdomen was tender and resistant all over, but not distended; these signs were most marked in the right iliac region. The whole lower abdomen was dull on percussion, and there was shifting dullness in the loins. The uterus was enlarged to the size of a five months' pregnancy.

Operation

The abdomen was opened through a right pararectal incision, and a quantity of turbid inoffensive fluid escaped. A large mass occupying the right side proved to be an acutely